Rhode Island State Energy Plan

Advisory Council Meeting #6

July 12, 2013

Advisory Structure

Advisory Council

- Meets on a monthly basis
- Evaluates and provides feedback on research to assist staff in preparing a Preliminary Draft Plan
- Recommends Preliminary Draft Plan to the State Planning Council's Technical Committee for forwarding to the State Planning Council for public hearing, revision, and adoption

Timeline

Project Phases

Phase I: Research & Data Collection (December 2012 – May 2013) Gather and synthesize the best available energy data
Phase II: Preparation of Preliminary Draft Plan (June 2013 – September 2013) Set measurable goals based on modeling analysis and stakeholder feedback; Design an actionable implementation strategy Distill research developed during Phase I into a Preliminary Draft Plan
Phase III: Technical & Public Review (October 2013 – March 2014) Vet Preliminary Draft Plan through a technical and public review process; Adopt Plan as State Guide Plan Element

Today

July Meeting Agenda

- Today we will be viewing **preliminary** results of Navigant’s scenario modeling:
  - Results are not final
  - Further improvements will be made to data and assumptions
  - Seeking Advisory Council input to help inform

Today

A reminder of what the scenario modeling is:

- Scenario modeling ≠ forecast or projection
- Scenario modeling ≠ recommendations of the Rhode Island State Energy Plan

- Scenario modeling looks at **different changes in RI's supply and demand energy profile** and how they might **impact key directional objectives** with respect to a business-as-usual forecast that only takes into account **existing** policies

Today

What are the scenarios we modeled?

- We developed a broad stakeholder consensus among the Advisory Council and the RISEP Project Team to model 3 unique, independently-viable scenarios representing 3 different paths for Rhode Island
- One scenario focuses on security, one scenario focuses on economics, and one focuses on sustainability
- This means that you may not see everything you want in one scenario
  - For instance, the model focusing on sustainability objectives seeks the most cost-effective ways to achieve environmental end goals

Today

How will the modeling results ultimately be used?

- The recommendations of the Plan will draw from each of the scenarios
- Modeling results will be used to help support Plan recommendations, but the recommendations may not be cut and paste from the modeling “word for word”

Today

What impact do existing policies have on the modeling?

- Navigant reports results **with respect to a “business-as-usual” baseline (BAU)**
- ENE developed BAU projections for consumption, prices, expenditure and emissions based on the current fuel mix and **existing** policies:
  - Least Cost Procurement
  - RGGI
  - RES
  - Federal CAFE Standards
- Renewable capacity and generation associated with the existing DG program, LTC program, and the 150 MW offshore wind project are baked into Navigant’s reference case in the model

Today

TAKE HOME:
What is the ultimate purpose of the modeling?

- This hasn't been done before → starting point
- We are looking for order of magnitude impacts
  - For example: Do climate objectives cost more? If so, do they cost 20% or 200% more than a business-as-usual case?
- What are the cross-sector impacts of **significant transformations** of our energy system?

Today

Other supporting analyses are going forward

- **Large Hydro Opportunities Study by NESCOE**
- **NREL Solar Value/SRP Study** - Completed by September 2013
- **DG Economic/Jobs/Environmental Report** - Due by January 15, 2014 to General Assembly

"All models are wrong, but some are useful"

\- George E. P. Box

NAVIGANT ENERGY

AQUINERGY
Experts in Renewable Energy and Sustainable Development

RHODE ISLAND STATE ENERGY PLAN TECHNICAL ASSISTANCE

Advisory Council Meeting – Preliminary Model Results

RIEDC Rhode Island Economic Development Corporation
Rhode Island, Working Again.

REF Renewable Energy Fund
A Program of the Rhode Island Economic Development Corporation

July 12, 2013

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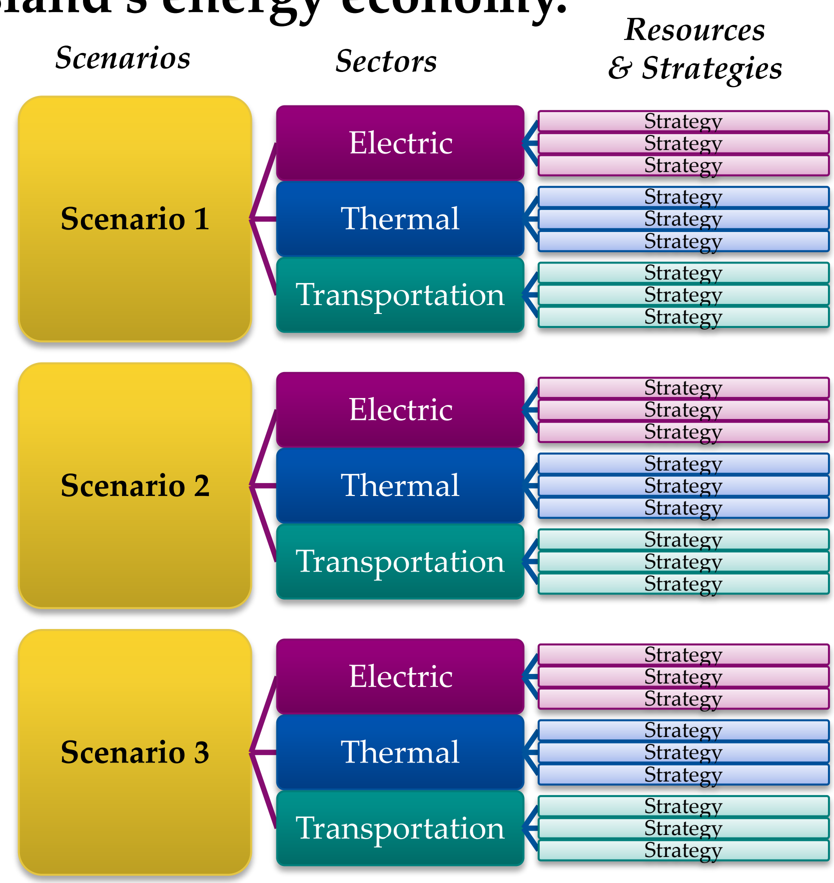
Today's agenda will include the following items:

1. Scope
2. Model Overview and Key Drivers
3. Summary of Results by Sector
4. Scenarios Setup and Results
5. Next Steps

NAVIGANT ENERGY

Navigant was tasked with developing strategies spanning the electric, thermal, and transportation sectors, and modeling their effects on Rhode Island's energy economy.



Security	Economics	Sustainability
+++	-	+
-	++	+++
+	+++	+

With input from the Steering Committee, Navigant modeled changes in resources across three scenarios to examine the trade-offs between energy security, economics, and sustainability.

NAVIGANT ENERGY

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NAVIGANT ENERGY

The electric sector was modeled using Navigant's Portfolio Optimization Model (POM) while the thermal and transportation sectors were modeled using a modular flow model using a mix of low, moderate, and aggressive resource targets.

Electric

- For this study the entire ISO-NE footprint is represented, which includes all individual units.
- POM determines the optimal unit build-out and dispatch to meet load requirements, RPS requirements, and additional system operating constraints.
- In the different scenarios, POM considers a variety of constraints, including in-state generation requirements, fuel diversity requirements, REC trading, and in-state RPS requirements.
- POM outputs include the marginal cost of generation as well as the costs to meet the different scenario constraints.

Thermal and Transportation

- The spreadsheet-based modular flow model converts the effects of resources to a common basis and performs a separate impact analysis for each resource, accounting for annual changes in allocation of each resource considered.
- The model then incorporates economic and technical attributes of each resource based on Navigant research and calculates the first-order effects of adopting a set of resources on the economic, fuel-based, and environmental directional objectives.
- The results of these scenarios are then compared with the ENE BAU Forecast.

NAVIGANT ENERGY

The business as usual (BAU) case was developed with inputs from the ENE's task 2 analysis, Navigant reference case assumptions, and inputs from the steering committee.

ENE Task 2

1. Rhode Island demand forecast
2. Rhode Island system costs

Navigant

1. CELT Report load forecast for rest of NE
2. New England electric infrastructure
3. Fuel cost forecast
4. Non-RI generation build-out and costs
5. Non-RI renewable resource availability

Steering Committee

1. Rhode Island Infrastructure Build-Out

The BAU Case

1. POM load was created from CELT load and benchmarked to ENE load for RI by adding energy efficiency resources.
2. Rhode Island build-out was loaded into POM.
3. POM system costs were benchmarked to ENE system costs to create a basis for comparing scenarios.

Results from scenario modeling are presented in contrast with the BAU.

The BAU case used in the electric sector was created by benchmarking BAU results from ENE's Task 2 report to ISO-NE infrastructure assumptions provided by Navigant

New Builds

- The BAU case shows 262MW of new renewables in Rhode Island by 2035, 180MW of which are off-shore wind projects.

(MW)	Rest of NE	RI
BIOMASS	300.00	-
CC	2,795.16	-
CTGAS	1,400.00	-
Solar	810.47	66.00
WIND	4,218.37	16.00
WIND_OFF	-	180.00

- The rest of ISO-NE is building a considerable amount of wind due to RPS mandates.
- The BAU case assumes the inclusion of 1200MW of hydroelectric transmission capacity from Canada.

Load Forecast

- The load forecast shows a 25% reduction in demand from 2013 to 2035.
- The main cause of demand reduction is the increased penetration of energy efficiency in all sectors.
- Due to the falling demand and renewable mandates, the BAU case shows no thermal additions throughout the forecast period.

Benchmarking ENE BAU

- The load forecast and BAU system costs come from the ENE BAU case from Task 2 of this project.
- The load forecast has the same shape as the forecast in the 2013 CELT report, but the total load and energy efficiency penetration for RI is taken from the load reported by ENE.
- System costs are benchmarked to the ENE case by scaling the costs reported by POM to the ENE values in the BAU case. All side case costs maintain the same benchmarking to provide a consistent basis for comparison.

NAVIGANT ENERGY

The Business As Usual (BAU) case in each sector is dominated by a few key drivers and resource characteristics

Electric

- Rhode Island accounts for a small fraction of ISO-NE load and thereby state policies have a minimal impact on wholesale energy prices.
- New construction is largely driven by regulatory requirements such as RPS mandates.
- Due to resource limitations and declining load, RPS requirements are usually met by financing out-of-state resources.

Thermal

- Substantial growth in demand in the industrial sector dominates the BAU forecast and provides clear opportunities for efficiency retrofits and CHP.
- While demand reduction efforts yield positive economic returns in the near term (CapEx), the long term energy savings have negative repercussions for economic activity (fuel expenditures).

Transportation

- Changes in energy demand in the Transportation sector are heavily influenced by the large capital requirements associated with changes to the fleet.
- Despite the large capital expenditures, the cumulative effects of reduced demand for fuel have large negative repercussions for economic activity (revenues, taxes, and jobs associated with fuel delivery)

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NAVIGANT ENERGY

Results of the modeling exercise demonstrate the tradeoffs between scenarios in the electric sector.

	Metric	Units	BAU	Scenario 1: Prioritize Security	Scenario 2: Prioritize Economics	Scenario 3: Prioritize Sustainability
Secure	Diversity of Fuels Used to Meet In-State Demand	Dominant fuel source in 2035 (%)	87%	50%	87%	85%
	Grid Tied Storage	MW in 2035	0	200	0	150
	Stability, Reliability, Resiliency	+/-	N/A	+++	-	+
Economic	Average Annual Electric Energy Expenditures*	$2012 Millions	902	1,119	934	1,090
	Average Cost of Electricity*	$2012/MWh (Wholesale)	$59.76	$59.81	$59.74	$59.43
	Average Price Volatility of LMPs	Index in 2035 (Relative to BAU)	1	0.926	0.999	0.961
	Economic Activity (Total In-State Expenditures*)	$2012 Millions	21,959	22,365	22,296	23,383
	In-State Employment Impact* (Relative to BAU)	Job Years	N/A	3,444	20	1,170
Sustainable	GHG Reductions (RI Load Served)	% below 2013 levels in 2035	23%	35%	23%	56%
	NOx & SO2 (RI)	% below 2013 levels in 2035	14%	57%	14%	14%
	Land Use Conversion	Acres	408	2,072	426	651

- Averages and totals are across the analysis period spanning 2013-2035
- Wholesale costs only consider marginal cost to meet load, system costs include all electric system infrastructure expenditures

NAVIGANT ENERGY

Results of the modeling exercise demonstrate the tradeoffs between scenarios in the thermal sector.

	Metric	Units	BAU	Scenario 1: Prioritize Security	Scenario 2: Prioritize Economics	Scenario 3: Prioritize Sustainability
Secure	Diversity of Fuels Used to Meet In-State Demand	Dominant fuel source in 2035 (%)	67%	62%	74%	63%
	Thermal Storage (ETS)	MW in 2035	0	1,067	0	217
	Stability, Reliability, Resiliency	+/-	n/a	+++	+	++
Economic	Average Annual Thermal Energy Expenditures*	$2012 Millions	$1,126	$1,148	$1,062	$1,092
	Average Cost of Energy*	$2012/MMBTU	$18.07	$18.67	$17.43	$17.74
	Average Price Volatility of Fuels	Index in 2035 (Relative to BAU)	1.000	0.961	0.976	0.963
	Economic Activity (Total In-State Expenditures*)	$2012 Millions	$0	$1,917	($1,616)	$1,063
	In-State Employment Impact* (Relative to BAU)	Job Years	0	1,275	(1,534)	538
Sustainable	GHG Reductions (RI Load Served)	% below 2013 levels in 2035	8%	25%	8%	34%
	NOx & SO2 (RI)	% below 2013 levels in 2035	19%	80%	41%	80%

* Averages and totals are across the analysis period spanning 2013-2035

NAVIGANT ENERGY

Results of the modeling exercise demonstrate the tradeoffs between scenarios in the transportation sector.

	Metric	Units	BAU	Scenario 1: Prioritize Security	Scenario 2: Prioritize Economics	Scenario 3: Prioritize Sustainability
Secure	Diversity of Fuels Used to Meet In-State Demand	Dominant fuel source in 2035 (%)	56%	32%	34%	39%
	Grid Tied Storage (EV Battery)	MW in 2035	137	1277	1277	6292
	Stability, Reliability, Resiliency	+/-		+++	+	+++
Economic	Average Annual Transportation Fuel Expenditures*	$2012 Millions	$1,696	$1,098	$1,096	$1,132
	Average Cost of Fuels*	$2012/MMBTU	$29.87	$29.75	$29.45	$30.22
	Average Price Volatility of Transportation Fuels	Index in 2035 (Relative to BAU)	1.000	1.013	1.018	0.999
	Economic Activity* (Total In-State Expenditures)	$2012 Millions	$0	$4,187	$2,194	($9,179)
	In-State Employment Impact* (Relative to BAU)	Job Years	0	528	(317)	(5,454)
Sustainable	GHG Reductions (RI Load Served)	% below 2013 levels in 2035	11%	54%	52%	56%
	NOx & SO2 (RI)	% below 2013 levels in 2035	19%	52%	51%	65%

* Averages and totals are across the analysis period spanning 2013-2035

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NAVIGANT ENERGY

Scenario 1 prioritizes energy security through fuel diversification and grid modernization.

Electric	Thermal	Transportation
• Targets a diverse power generation portfolio which does not rely on any one fuel source for more than 50% of generation by 2035. • Aims to increase grid reliability through deployment of smart meters and grid tied storage.	• Promotes the adoption of a diverse set of options for heating and space conditioning across the residential, commercial, and industrial sectors. • Provides load shifting through aggressive deployment of ETS.	• Promotes energy security in the transportation sector through a diverse portfolio of transportation fuel options including CNG, PEVs, and biofuels as well as increases in fleet efficiency and public transit options.

MODEL OBJECTIVE FUNCTIONS & TARGETS

SECURITY	ECONOMICS	SUSTAINABILITY
• Minimize contributions of the dominant fuel source • Target a balance of 50% in-state and 50% out of state generation by 2035 • Maximize build out of energy storage technologies and DR capabilities • Maximize diversity of fuels in Thermal and Transportation	• Change in 'Job Years' is positive • Meet all other criteria in the most cost effective manner	• 40% renewables (25% in state)

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Highlights of the changes modeled in Scenario 1 include reliance on gas fired generation for 50% of demand and 200 MW of grid tied storage.

Electric Sector

- By 2035, average system costs are 24% higher than in the BAU.
- In-state renewable build includes 70 MW on-shore wind, 302 MW solar, 7.5 MW biomass, and 180 MW off-shore wind. Additionally, 228 MW of out-of-state wind is financed to meet the RPS.
- The most cost-effective solution to reducing reliance on natural gas is to increase imports into Rhode Island.
- Once the 50% import limit is reached, Rhode Island builds renewable resource in-state to reach the required fuel diversity metric.
- This scenario exhibits significantly less volatile wholesale energy prices relative to the BAU.

Thermal Sector

- Scenario 1 sees substantial build out of ETS to shift load creating a more stable grid and renewable thermal resources to diversify away from fossil fuel powered heating

Transportation Sector

- Natural Gas powered transportation doubles in market share from the BAU, rivaling gasoline and diesel fuel.

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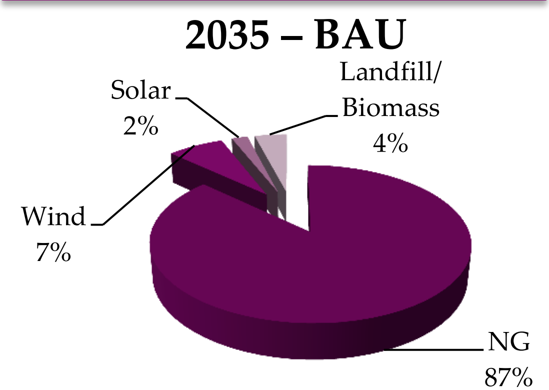
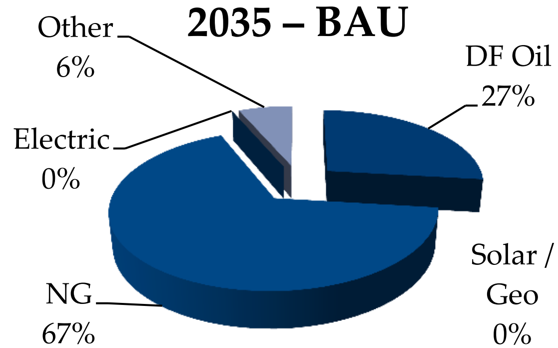
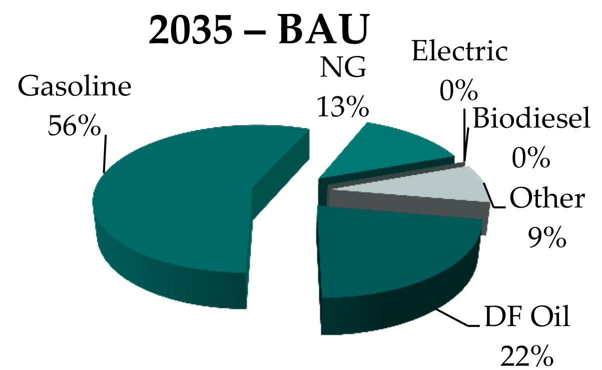
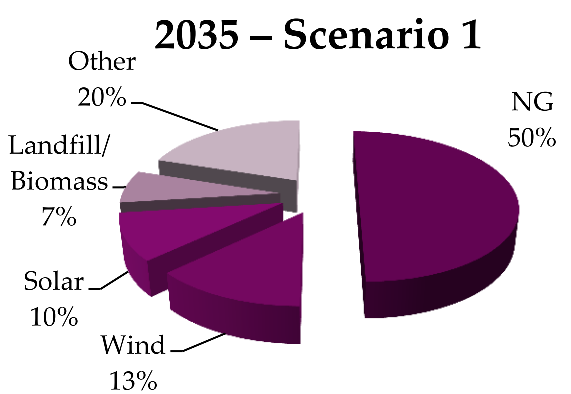
In Scenario 1, Natural Gas is constrained to meet only 50 % of electric demand (87% in the BAU case), Renewables take over 8% of the thermal energy market, and AFVs reach 34% of the market.

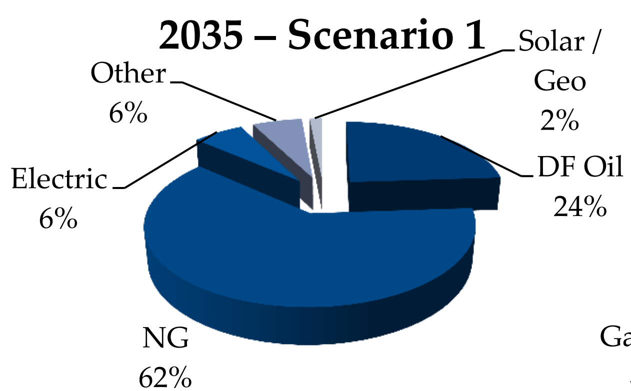
Electric Sector | **Thermal Sector** | **Transportation Sector**

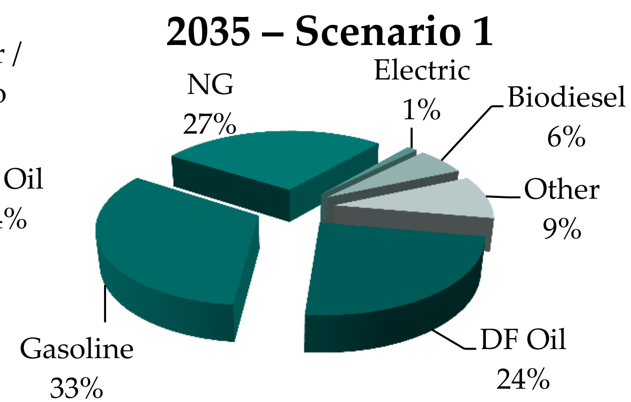












*Electric Sector 'Other' includes: large-scale hydro, nuclear, and oil
**Thermal Sector 'Other' includes: gasoline, kerosene, propane and residual fuel oil.
***Transportation Sector 'Other' includes: ethanol E85, jet fuel, propane and residual fuel oil.

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Scenario 2 prioritizes cost effectiveness and economic development while hitting key targets for GHG reduction.

Electric

- Minimizes electricity expenditures through demand side management while promoting economic development and meeting established targets for GHG reduction.

Thermal

- Targets a 10% reduction in total thermal energy expenditures by 2035.

Transportation

- Aims to cut transportation related fuel expenditures through programs that dramatically increase vehicle average efficiency and provide for cost effective public transit options.

MODEL OBJECTIVE FUNCTIONS & TARGETS

SECURITY	ECONOMICS	SUSTAINABILITY
• Net increase in diversity of fuels used to meet demand	• Minimize expenditures across all sectors • Change in 'Job Years' is positive • **Meet all other criteria in the most cost effective manner**	• 25% renewables by 2035

NAVIGANT ENERGY

Highlights of the changes modeled in Scenario 2 include a substantial reduction in expenditures in the thermal and transportation sectors.

Electric Sector

- Total expenditures are the lowest of any scenario, however they remain slightly higher than the BAU case due to the imposition of a higher RPS mandate and increased electrification of other sectors.
- The In-state renewable build includes 16 MW on-shore wind, 66 MW solar, and 180 MW off-shore wind. Additionally, 11 MW of out-of-state wind is financed to meet the RPS.
- The primary deviations from the BAU case include a higher RPS mandate and higher load in the residential and transportation sectors.

Thermal Sector

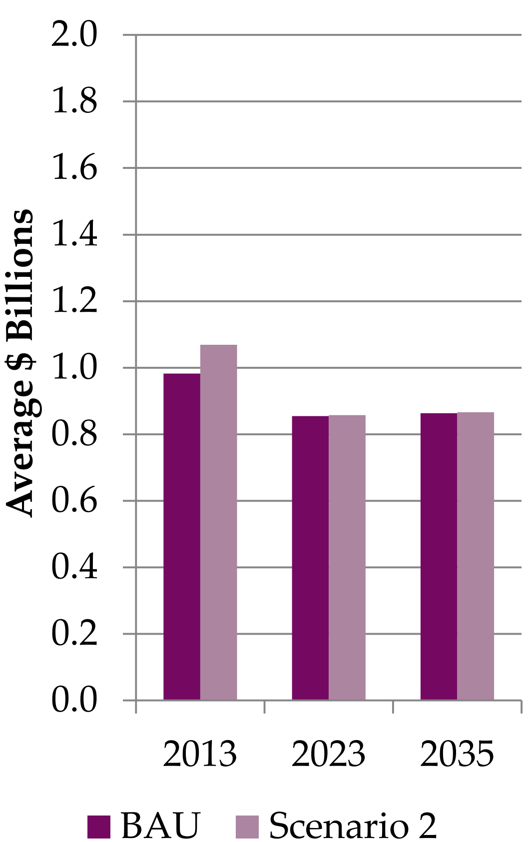
- Extensive deployment of CHP and industrial efficiency measures drive down aggregate expenditures in the thermal sector, resulting in lower average costs of energy with less capital investment than alternatives.

Transportation Sector

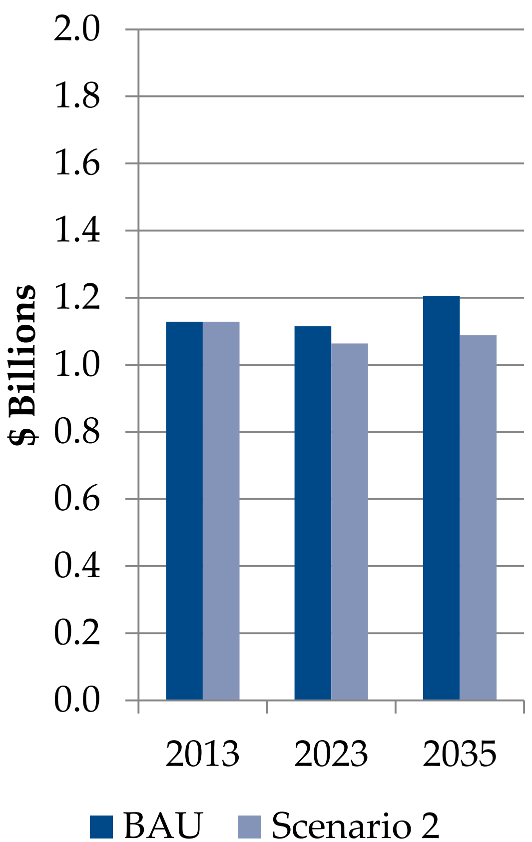
- Annual fuel expenditures drop by more than half by 2035 owing to drastic increases in average fleet MPG and moderate vehicle electrification.

In Scenario 2, total electric expenditures increase slightly to keep pace with increased RPS and increased electrification, whereas thermal and transportation fuel expenditures drop to 90% and 41% of the BAU, respectively.

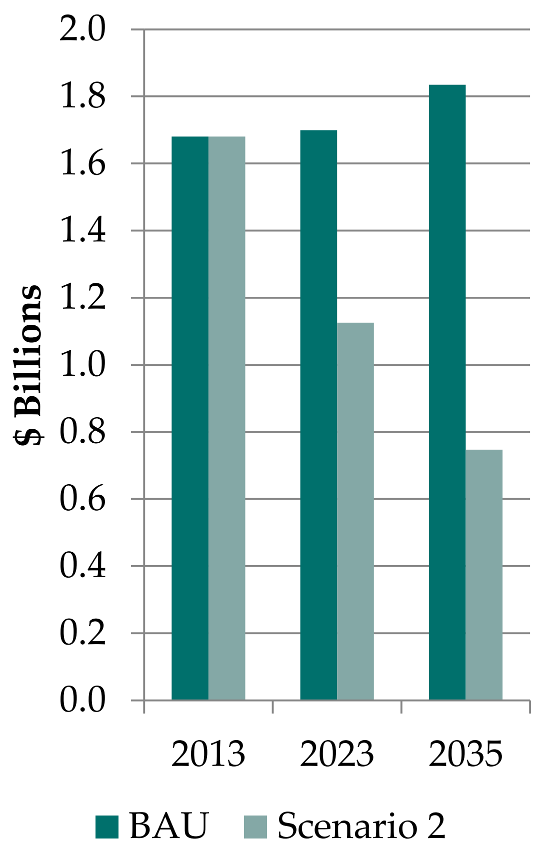
Electric Sector



Thermal Sector



Transportation Sector



* Electric sector figures are averages across the periods 2013 – 2020, 2021 – 2028, and 2029 – 2035 to eliminate spikes from single year infrastructure investments.

NAVIGANT ENERGY

Scenario 3 prioritizes sustainability through the widespread deployment of renewables, thermal alternatives, and vehicle electrification.

Electric

- Aims to cut regional GHG by targeting a high penetration of renewables
- Targets security through the construction of energy storage facilities.

Thermal

- Aims to cut in-state GHG emissions through substantial adoption of heating by solar thermal, geothermal, and a switch to biofuels.

Transportation

- Aims to aggressively cut transportation related pollution through widespread vehicle electrification, modest gains in vehicle efficiency, and expansive public transit options.

MODEL OBJECTIVE FUNCTIONS & TARGETS

SECURITY	ECONOMICS	SUSTAINABILITY
• Build out energy storage technology at pace with renewables	• Change in 'Job Years' is positive • **Meet all other criteria in the most cost effective manner**	• 25% renewables by 2023 • 75% renewables by 2035 • Maximize reduction in transportation and thermal sector GHG subject to other constraints

NAVIGANT ENERGY

Highlights of the changes modeled in Scenario 3 include 1,165 MW of new renewables, deep thermal efficiency retrofits, and 46% of transportation energy needs coming from alternative fuels in 2035.

Electric Sector

- There is a 54% decrease in CO_2 emissions by 2035 from 2013 levels. To some extent, increased carbon efficiency in the electric sector is offset by significantly increased electrification of other sectors.
- In-state renewable build is 70 MW on-shore wind, 66 MW solar, and 180 MW off-shore wind. Additionally, 1,111 MW of out-of-state wind is financed to meet the RPS.
- Due to high EE penetration, load can be met with existing generating resources, reducing the incentive to meet the RPS requirement through in-state development.
- The results show 21% increase in total system expenditure vs. the BAU.

Thermal Sector

- Emissions from this sector drop below 50% of those in the BAU by 2035 resulting from a high penetration of solar and geothermal heating (combined BBTU/year in 2035).

Transportation Sector

- Emissions in the transportation sector are cut dramatically (44% of the 2013 BAU level) through an expansive roll out of public transit options and city planning which discourages single occupancy vehicles combined with widespread electrification and switching to lower carbon fuels like CNG.

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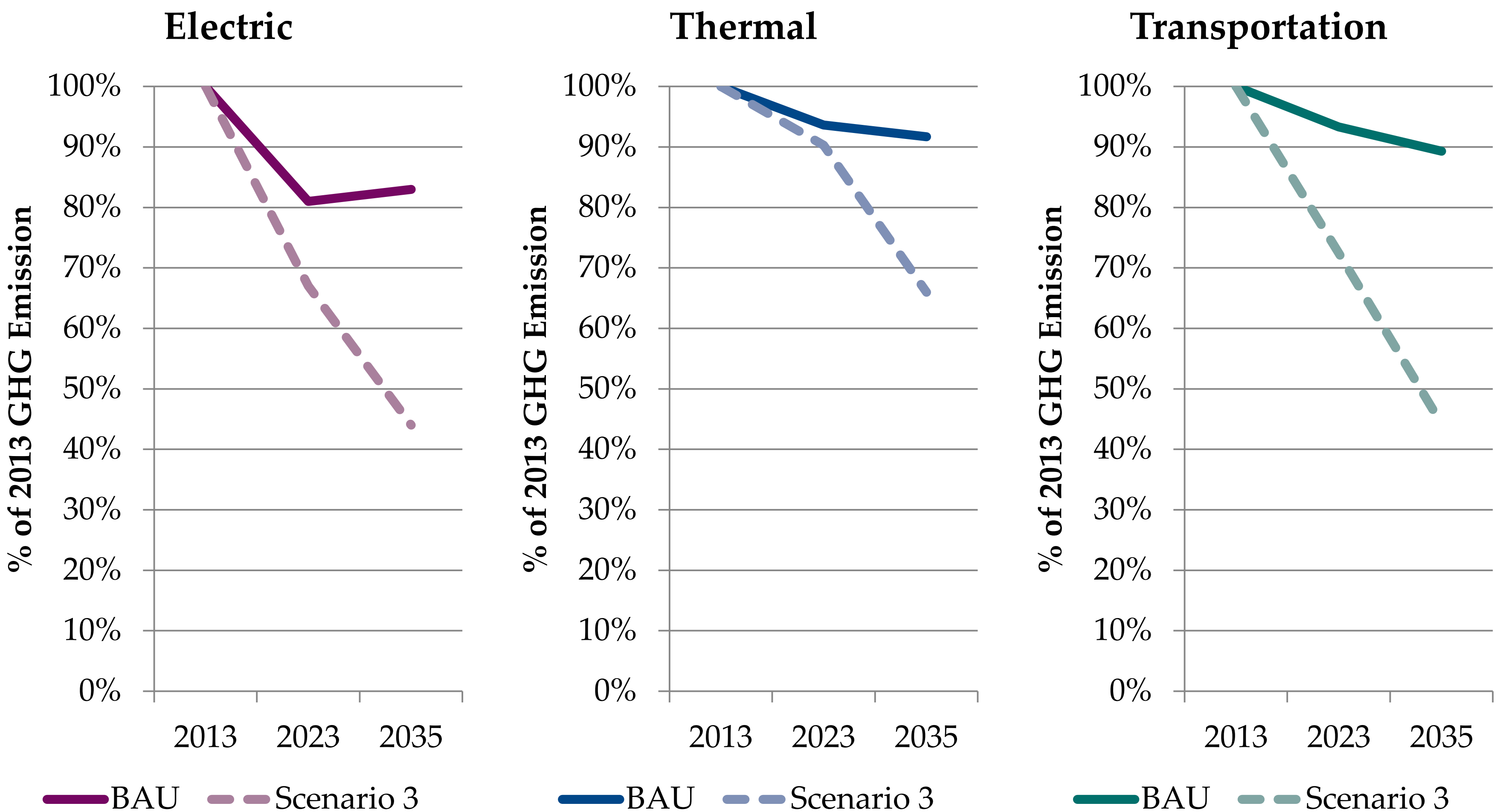
In Scenario 3, GHG emissions drop by 56%, 34%, and 56% below 2013 levels of the BAU case in 2035, across the three sectors respectively.



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NAVIGANT ENERGY

Following this meeting, Navigant will solicit feedback, finalize the scenarios and model results, and facilitate handoff to the RISEP Steering Committee.

Solicit Feedback

- Distribute Model Results
- Collect Feedback
- Propose Modifications and Adjustments

Finalize Scenarios

- Integrate feedback from Steering Committee and Advisory Council
- Update Results

File Report

- Complete the Report
- Compile Additional Documentation
- Write Executive Summary
- Facilitate Handoff

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Next Steps

Next Steps

- Advisory Council members will provide feedback on **preliminary modeling results** via email to OER **by Wednesday, July 24th COB**
- The next Advisory Council meeting will be scheduled for **late August or early September**
- The focus of the next meeting will be **developing policy recommendations** of the Plan

Rhode Island State Energy Plan

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